IR Geometry

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IR Design Criteria

- Separation scheme to avoid parasitic beam-beam collisions
  35nsec distance between bunches -> 10.5m
  First possible parasitic collision at 5.25m from IP
- Electron β^* = 10cm; ion β^*= 25cm
- Synchrotron radiation load in the IR
- Longitudinal polarization in interaction point.
- Minimal depolarization from separation and spin rotation schemes. Spin transparency conditions
- Detector background, protection from synchrotron radiation issues

- Second (parasitic) crossing between electron and ion rings.

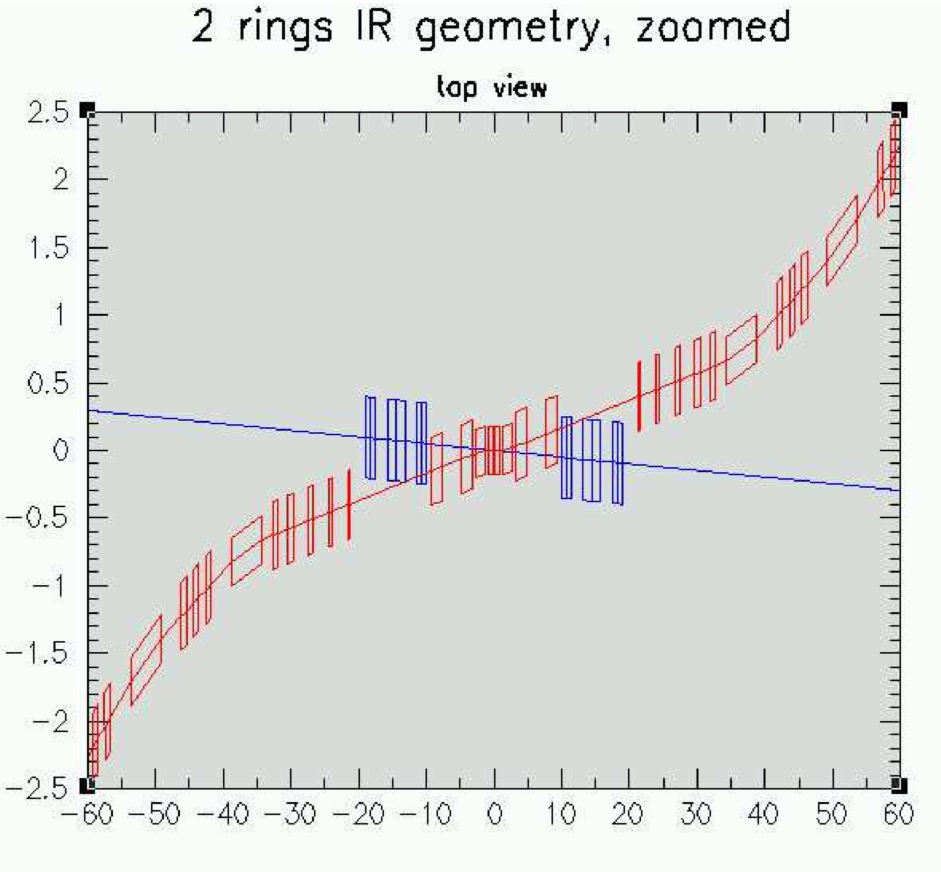
Two IR designs under consideration

- Based on v.1.0 lattice of electron and ion rings
  - Flat electron and Blue ion rings, 3m vertical excursion in Yellow ion ring.
  - Head-on collisions.
  - Beam separation looks OK
  - Problem: synchrotron radiation accommodation.

- Brett's design (v.1.1?)
  - All rings are flat
  - Effective beam separation. Using special magnet design.
  - Synchrotron radiation load problem is solved.
  - Problem: requires +-6mrad crossing angle.

Optimal design?

eRHIC interaction region geometry with lattice release 1.0

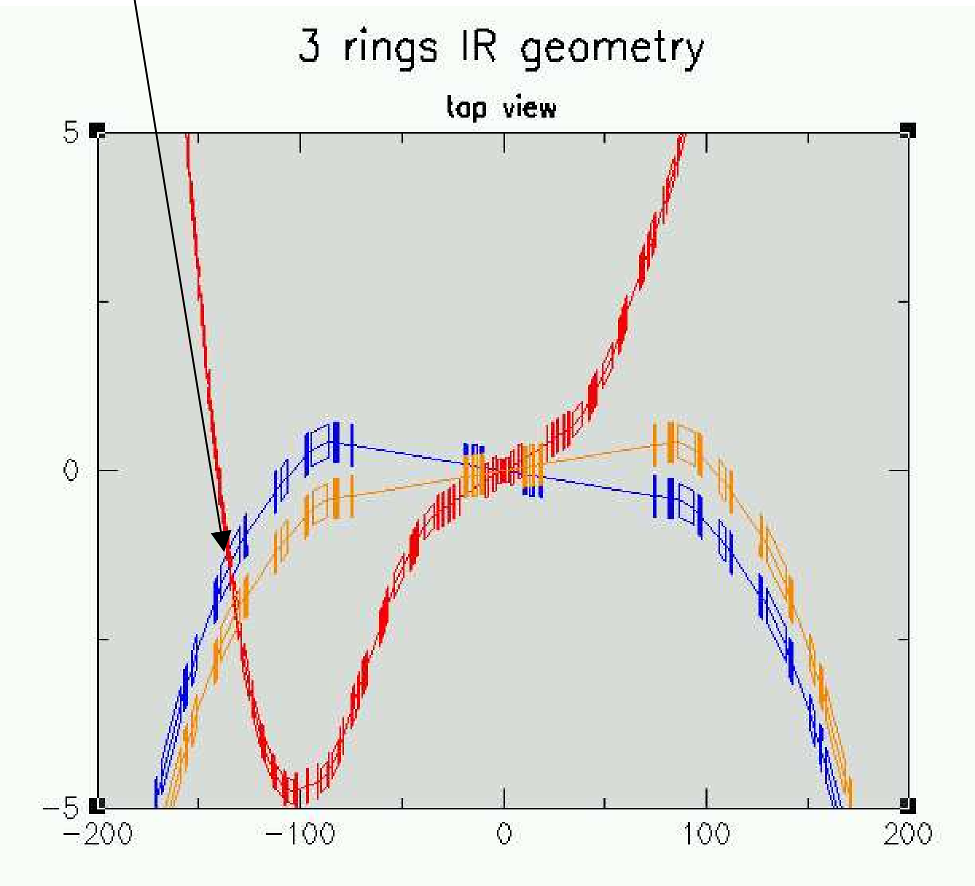


❖Head-on collisions

❖ 25 mrad separation angle produced by IR magnets (6 mrad in Brett's design)

Second crossing problem

Second crossing happens at `D8` magnet region

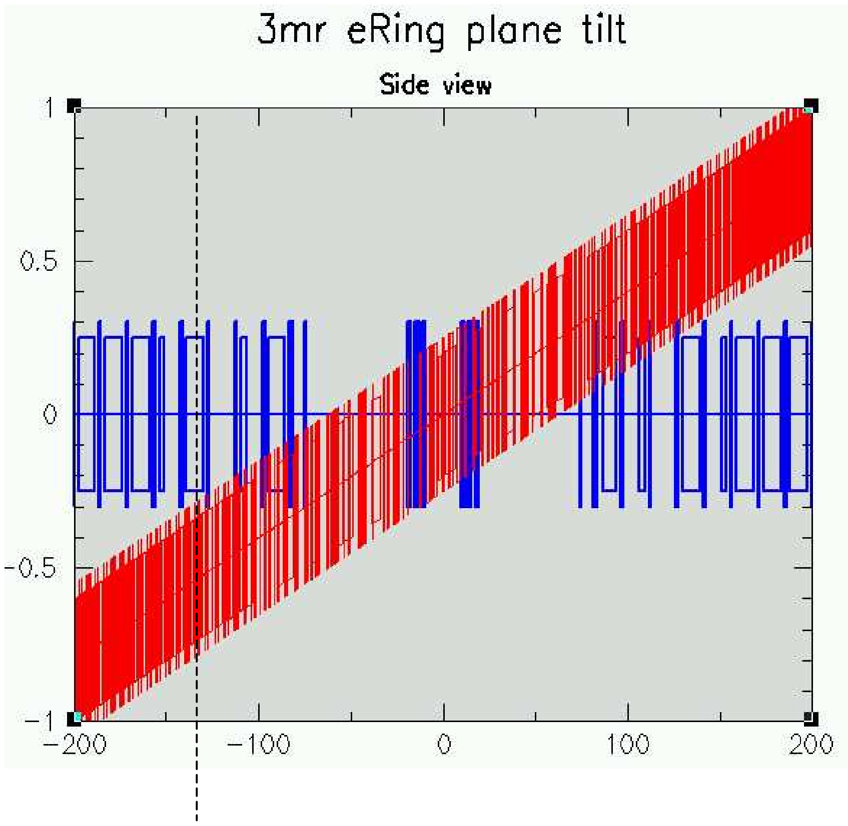


Possible approaches to solve it:

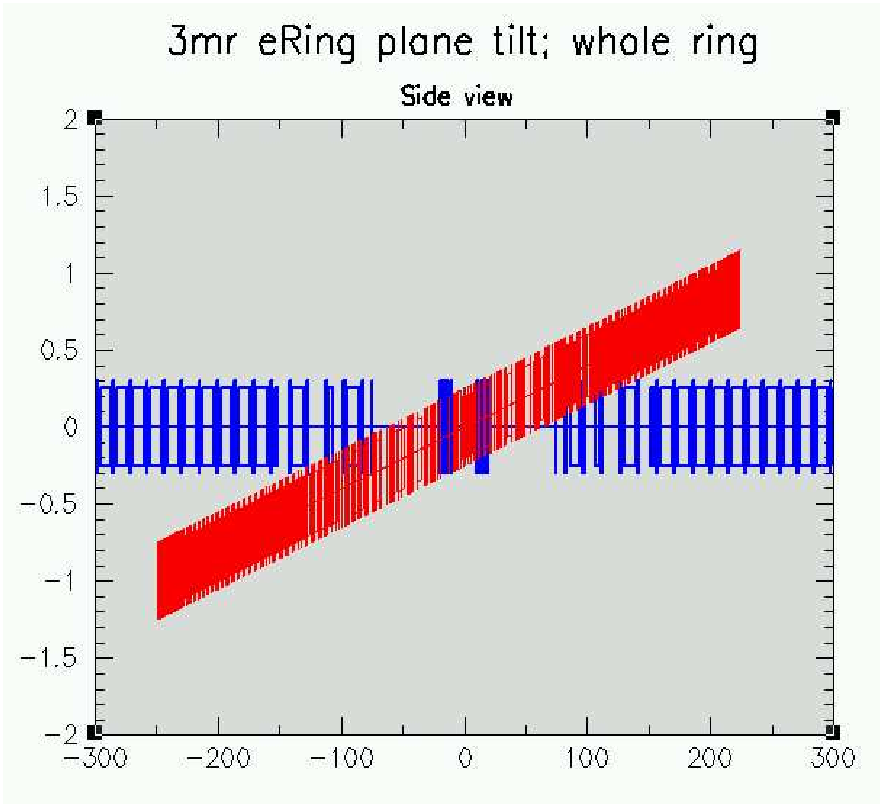
- Vertical excursion of ion ring (0.5-1.5m);

  Problem with vertical dispersion matching.
- Allowing second crossing in warm ion ring region
- Using electron ring with tilted plane.

Electron ring plane is tilted to avoid second crossing.
With cryostat diameter 0.6m at least 3mr tilt is needed.



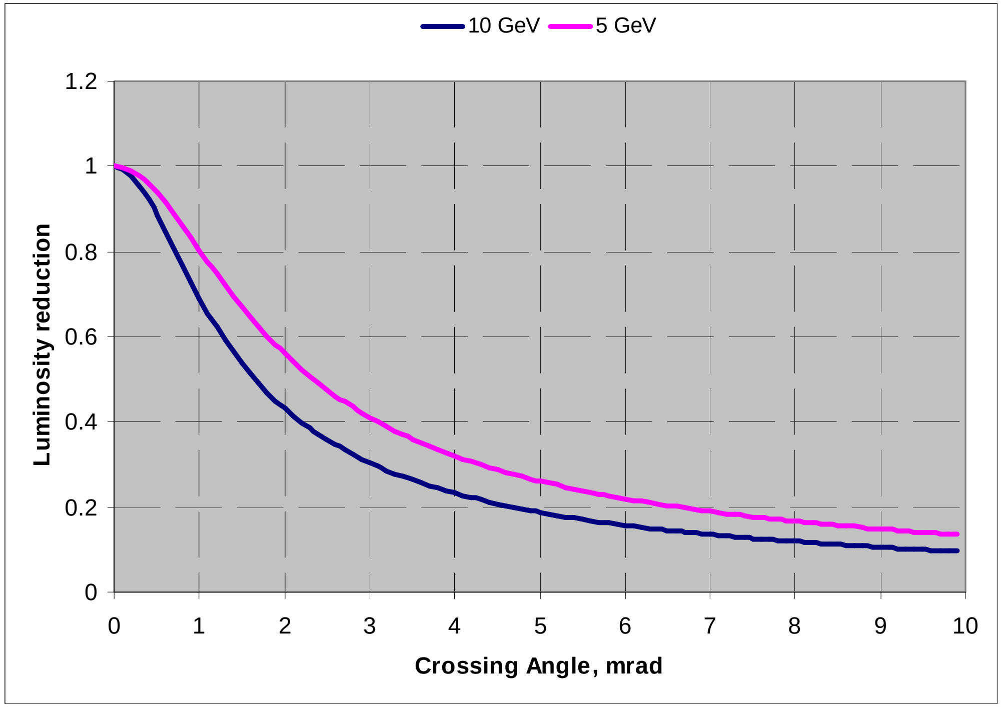
Second crossing point



Luminosity versus crossing angle

$$L = \frac{L_0}{\sqrt{1+\frac{\left(\sigma_{li}^2+\sigma_{le}^2\right)\cdot\theta^2}{8\cdot\sigma_x^2}}}$$

Luminosity reduction factor



For 20cm ion bunch length
20% luminocity reduction:
at 0.45mrad Xangle at 10GeV
at 0.6 mrad Xangle at 5GeV

To allow large Xangle:

- bunch length decrease (10cm)
- σ_x increase (flat beam?)

Obtained result for cryogenic power load (at 10^{11} particles per bunch):